

**INTERNATIONAL COOPERATION TREATY**  
**PCT**  
**INTERNATIONAL PRELIMINARY EXAMINATION REPORT**

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference fp12259	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).	
International Application No. <b>PCT/AU00/00099</b>	International Filing Date (day/month/year) 14 February 2000	Priority Date (day/month/year) 12 February 1999	
International Patent Classification (IPC) or national classification and IPC <b>Int. Cl. 7 G02B 6/10, B23K 26/36</b>			
<b>Applicant</b> <b>THE UNIVERSITY OF SYDNEY et al</b>			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.

This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 4 sheet(s).

3. This report contains indications relating to the following items:

I	<input checked="" type="checkbox"/> Basis of the report
II	<input type="checkbox"/> Priority
III	<input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
IV	<input type="checkbox"/> Lack of unity of invention
V	<input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
VI	<input type="checkbox"/> Certain documents cited
VII	<input type="checkbox"/> Certain defects in the international application
VIII	<input type="checkbox"/> Certain observations on the international application

Date of submission of the demand 31 August 2000	Date of completion of the report 30 April 2001
Name and mailing address of the IPEA/AU  AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer  <b>M.E. DIXON</b> Telephone No. (02) 6283 2194

## I. Basis of the report

## 1. With regard to the elements of the international application:\*

the international application as originally filed.

the description, pages 1, 4-9, as originally filed,  
pages , filed with the demand,  
pages 2, 3, received on 10 April 2001 with the letter of 9 April 2001

the claims, pages , as originally filed,  
pages , as amended (together with any statement) under Article 19,  
pages , filed with the demand,  
pages 10, 11, received on 10 April 2001 with the letter of 9 April 2001

the drawings, pages 1/7-7/7, as originally filed,  
pages , filed with the demand,  
pages , received on with the letter of

the sequence listing part of the description:  
pages , as originally filed  
pages , filed with the demand  
pages , received on with the letter of

## 2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language which is:

the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

the language of publication of the international application (under Rule 48.3(b)).

the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

## 3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, was on the basis of the sequence listing:

contained in the international application in written form.

filed together with the international application in computer readable form.

furnished subsequently to this Authority in written form.

furnished subsequently to this Authority in computer readable form.

The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

4.  The amendments have resulted in the cancellation of:

the description, pages

the claims, Nos.

the drawings, sheets/fig.

5.  This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).\*\*

\* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

\*\* Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Claims 1-21	YES
	Claims	NO
Inventive step (IS)	Claims 1-21	YES
	Claims	NO
Industrial applicability (IA)	Claims 1-21	YES
	Claims	NO

**2. Citations and explanations (Rule 70.7)**

The closest cited art is US 4978188. Figs 2D and 2E of this document show waveguides 4, 5 in cladding 12. Stress applying film 31 is formed on cladding 12. The last paragraph of col 10 of this document states that the power of laser beam 37 can be increased to evaporate (ablate) film 31 and that this phenomenon can also be employed to carry out trimming for adjusting birefringence, as far as it does not deteriorate the underlying layer 12.

However, there is no disclosure of inducing a stress to thereby alter an optical characteristic of the waveguide, as required by the present claims. Also reference to not deteriorating layer 12 would seem to lead away from inducing a stress.

Therefore the claims satisfy the requirements for novelty and inventive step.

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processing an optical device incorporating a waveguide, the method comprising the step of utilizing a laser to heat and thereby ablate a surface of the device so as to induce a stress in said optical device and thereby alter an optical 5 characteristic of the waveguide, wherein the power density of the laser is selected to effect surface ablation.

The laser may comprise a carbon dioxide laser source.

The method may be utilized to alter the birefringent properties of the waveguide, e.g. the TM and TE 10 birefringent modes may be substantially aligned.

The method may further comprise the step of masking the surface with a thermally conductive material having an aperture defined therein to limit exposure of the device to the laser.

15 The device may comprise a sensor.

The method may further comprise the step of depositing a material layer on the surface. Accordingly, the method itself may be utilised to form the device. The device may e.g. comprise a semiconductor device or a SiO<sub>2</sub>/Si 20 planar waveguide device.

Step of depositing the material layer may comprise depositing the material layer on portions of the surface affected by the ablation.

25 The material layer may be provided as an electrode for electrically contacting the device.

The method may further comprise the step of mounting a further component in a groove formed in the surface as a result of the ablation. The further component may comprise a modulator for modulating a characteristic of 30 the device.

The method may be conducted at different locations of the device so as to form an optical structure. The optical structure may comprise a grating structure. The optical structure may comprise a polarisation filter.

35 The method may be used to diminish UV induced changes present in the waveguide.

The device may comprise an optical fibre.

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The method may be utilised to mark the device by way of the ablation.

5 The laser may comprise a semiconductor laser operating at a wavelength of more than about 1.8 micro metre. This wavelength range may be preferable where the surface of the device comprises  $\text{SiO}_2$ .

The method may further comprise the step of providing an absorber material to facilitate the heating of the surface of the device.

10 The invention may alternatively be defined as providing an device incorporating a waveguide, wherein the device has been processed utilising a laser to heat and thereby ablate a surface of the device so as to induce a stress in said device and thereby alter an optical 15 characteristic of the waveguide, wherein the power density of the laser is selected to effect surface ablation.

Brief Description of the Drawings

20 Notwithstanding any other forms which may fall within the scope of the present invention, preferred forms of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 illustrates schematically the operation of the method of the preferred embodiment;

25 Fig. 2 illustrates the ablation of a wafer surface;

Fig. 3 illustrates the change and effective index in an experiment utilizing the preferred embodiment;

Fig. 4 illustrates a further change in the effective index of an experiment utilizing the preferred embodiment;

30 Fig. 5 illustrates the initial profile of a Mach-Zehnder (MZ) interferometer prior to application of preferred embodiment showing both the TM and TE modes;

Fig. 6 illustrates the spectral response for TE and TM modes of a MZ interferometer after application of the preferred embodiment for the device of Fig. 6;

35 Fig. 7 illustrates an alternative form of processing a wafer;

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We Claim:

1. A method of processing an optical device incorporating a waveguide, the method comprising the step of:
  - 5 - utilizing a laser to heat and thereby ablate a surface of the device so as to induce a stress in said optical device and thereby alter an optical characteristic of the waveguide, wherein the power density of the laser is selected to effect surface ablation.
  - 10 2. A method as claimed in claim 1 wherein the laser comprises a carbon dioxide laser source.
  3. A method as claimed in any one of the preceding claims wherein the method is utilized to alter the birefringent properties of the waveguide.
  - 15 4. A method as claimed in claim 3 wherein the TM and TE birefringent modes are substantially aligned by the method.
  5. A method as claimed in any one of the preceding claims further comprising the step of masking the surface with a thermally conductive material having an aperture defined to minimise exposure of the device to the laser.
  - 20 6. A method as claimed in any one of the preceding claims wherein the device comprises a sensor.
  7. A method as claimed in any one of the preceding claims further comprising the step of:
    - 25 - depositing a material layer on the surface.
    8. A method as claimed in claim 7, wherein the step of depositing the material layer comprises depositing the material layer on portions of the surface affected by the ablation.
    - 30 9. A method as claimed in any one of the preceding claims further comprising the step of:
      - 35 - mounting a further component in a groove formed in the surface as a result of the ablation.
      10. A method as claimed in claim 7 or 8, wherein the material layer is provided as an electrode for

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electrically contacting the device.

11. A method as claimed in claim 9, wherein the further component comprises a modulator for modulating a characteristic of the device.

5 12. A method as claimed in any one of the preceding claims wherein the step of utilising the laser to heat the surface is conducted at different locations of the device so as to form an optical structure.

10 13. A method as claimed in claim 12, wherein the optical structure comprises a grating structure.

14. A method as claimed in claims 12 or 13, wherein the optical structure comprises a polarisation filter.

15 15. A method as claimed in any one of the preceding claims wherein the method is used to diminish UV induced changes present in the waveguide.

16. A method as claimed in any one of the preceding claims wherein the device comprises an optical fibre.

20 17. A method as claimed in any one of the preceding claims wherein the method is utilised to mark the device by way of the ablation.

18. A method as claimed in any one of the preceding claims, wherein the laser comprises a semiconductor laser operating at a wavelength of more than about 1.8 micro metre.

25 19. A method as claimed in claim 18, wherein the surface of the device comprises SiO<sub>2</sub>.

30 20. A method as claimed in any one of the preceding claims, wherein the method further comprises the step of providing an absorber material to facilitate the heating of the surface of the device.

21. A device incorporating a waveguide, wherein the waveguide has been processed utilising a laser to heat and thereby ablate a surface of the device so as to induce a stress in said device and thereby alter an optical 35 characteristic of the waveguide, wherein the power density of the laser is selected to effect ablation.

## PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

Date of mailing (day/month/year)  
04 October 2000 (04.10.00)

To:  
Assistant Commissioner for Patents  
United States Patent and Trademark  
Office  
Box PCT  
Washington, D.C.20231  
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

International application No.  
PCT/AU00/00099

Applicant's or agent's file reference  
IHA:FP12259

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14 February 2000 (14.02.00)

Priority date (day/month/year)  
12 February 1999 (12.02.99)

## Applicant

CANNING, John et al

1. The designated Office is hereby notified of its election made:

in the demand filed with the International Preliminary Examining Authority on:

31 August 2000 (31.08.00)

in a notice effecting later election filed with the International Bureau on:

2. The election  was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

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